

UNITED STATES DEPARTMENT OF AGRICULTURE

**Soil Survey
of
Harlan County, Nebraska**

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and

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Nebraska Soil Survey



Bureau of Chemistry and Soils

In cooperation with the

University of Nebraska State Soil Survey

Department of the Conservation and Survey Division

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SOIL SURVEY

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SOIL SURVEY OF HARLAN COUNTY, NEBRASKA¹

By W. J. MORAN, United States Department of Agriculture, in Charge,
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COUNTY SURVEYED

Harlan County is in south-central Nebraska adjoining Phillips County, Kans. (fig. 1). Alma, the county seat, is 150 miles directly southwest of Lincoln. The county is 24 miles square and comprises 574 square miles, or 367,360 acres.

Physiographically the county is part of a broad gently eastward-sloping loess-mantled plain which has been modified by the valleys of Republican River, Sappa Creek, and Prairie Dog Creek, all of which flow in a general easterly direction, and by numerous north-south drainage ways tributary to these streams. Approximately 85 percent of the county is upland, and the remainder is alluvial land. The surface throughout about 50 percent of the upland lies near that of the old constructional plain and ranges from nearly level to very gently rolling. However, over most of the county the tributary drainage ways have carved the surface of the plain into a series of long nearly parallel north-south divides which extend at about right angles to the major streams. Few of the divides are more than a mile wide. They have nearly level tops and are separated from one another by rather deeply entrenched drainage ways. The largest unmodified remnants of the old plain are in the northeastern and north-central parts of the county, occupying most of Antelope Township and the northern parts of Scandinavia and Albany Townships. Here drainage channels are not developed and the surplus surface moisture collects in numerous shallow basinlike depressions locally known as "buffalo wallows" or "lagoons", from which it disappears slowly through seepage and evaporation. The basins range in size from a few square rods to more than a square mile.

The roughest land is in Republican City Township south of Republican River Valley. Rather rough land occurs in Turkey Creek Township east of Huntley, in the south-central part of Scandinavia Township, and throughout an area extending from east of Alma to west of Orleans on the south side of Republican River Valley. In these localities the drainage channels are more numerous than elsewhere and the upland surface has been carved into a rather intricate system of steep-sided canyons separated by narrow and, in many places, sharp divides. Tonguelike remnants of the former plain occur in numerous places, but the total area of level land is comparatively small, and over considerable areas, especially east of Prairie Dog Creek, practically all the land has been eroded until the surface is below the level of the former plain.

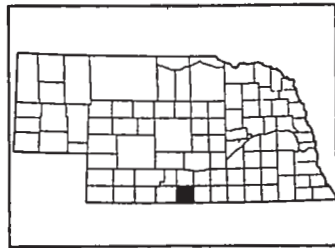


FIGURE 1—Sketch map showing location of Harlan County, Nebr.

¹ Report written by F. A. Hayes.

The minor drainage ways, particularly the longer ones, are narrow and canyonlike near their heads and become broader, with more gradually sloping valley sides, as they approach the trunk streams.

The alluvial lands, which include the terraces and flood plains, occur in continuous strips along Republican River and its larger tributaries. They range from a few rods to about 2½ miles in width. Those along the river and Prairie Dog and Sappa Creeks are the widest.

The terraces occur at several distinct levels, depending on the depth to which the streams had cut prior to the deposition of the terrace material. Most of the soil on the higher ones, especially along Republican River, has been removed by erosion. The broadest and among the highest terrace remnants are on both sides of Sappa Creek between Stamford and Orleans. Fairly continuous strips of this same terrace level are in Republican River Valley east of Orleans, in the vicinity of Alma, east of Republican City, and along Prairie Dog Creek. The surface of these high terrace remnants lies from 45 to 75 feet above the stream channels. Lower terraces, or benches, occur as small bodies or narrow strips along all the major streams and many of the smaller ones. They lie from 10 to 25 feet above the present bottom lands.

The surface of the terraces is nearly level or gently undulating, except where they are crossed by shallow drainage ways issuing from the uplands. The transition between the different terrace levels and to the flood plains is usually a short steep slope, and that between the terraces and upland is in most places long and gradual, especially on the north side of the major streams. On the south side of Republican River, the slopes between the upland and terraces are rather steep.

The flood plains occupy the lower positions along streams, occurring in strips of various widths bordering both sides of the channels. Their surfaces are nearly level, except where modified by old or present channels, slight elevations, or shallow depressions. They lie only a few feet above the level of the streams and are subject to inundation in places during periods of high water. However, in most places the slope down the valley and toward the channels is sufficient to remove the surplus water when the streams subside.

The average altitude of Harlan County is about 2,100 feet above sea level, ranging from approximately 1,890 feet where Republican River crosses the eastern boundary to about 2,340 feet in the uplands northwest of Ragan. The elevation² of Alma is 1,942 feet; of Orleans, 1,996 feet; of Stamford, 2,053 feet; of Republican City, 1,942 feet; of Ragan, 2,329 feet; and of Mascot, 2,127 feet above sea level. The general slope is to the south and east.

All the drainage is effected by Republican River. This stream and Prairie Dog and Sappa Creeks occupy very meandering courses, but they are rather swift flowing and are gradually deepening their channels. The minor drainage ways are rapidly intrenching themselves and increasing their drainage areas. The only poorly drained land is in the shallow basinlike depressions on the uplands and in local spots on the flood plains.

Well water of good but medium-hard quality is easily obtained in most parts of the county. The only difficulty in obtaining an abun-

² GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U S Geol. Survey Bul. 274, Ed. 4, 1,072 p. 1906

dant supply of water is experienced in places on the slopes and in the valleys of Republican River and Prairie Dog and Sappa Creeks, where the Pierre shale or Niobrara chalk are exposed or lie near the surface of the ground. Only a scanty supply of rather alkaline water is available in these formations. On the uplands between Republican and Prairie Dog Valleys the water is contained in Tertiary sands and gravels beneath a bed of rocks—the wells ranging from 100 to 150 feet in depth. Similar conditions prevail for a distance of a few miles north of Republican River, but in the northern part of the county the water is reached in sands lying above rock formations. The deepest wells are in the vicinity of Ragan, several wells being more than 200 feet deep. On the nearly level uplands in the northeastern part the wells range from 140 to about 200 feet in depth. Wells in the alluvial lands range from 12 to 30 feet, depending on the thickness of the alluvial deposits. In some places throughout the alluvial lands it has been rather difficult to obtain a sufficient supply of good water because the Pierre shale rises above the water table. A few springs occur at or near the contact zone of the Tertiary and Pierre formations on the valley slopes along Republican River and Prairie Dog Creek.

Native deciduous trees, chiefly willow, ash, elm, boxelder, hackberry, and cottonwood, grow in narrow belts along most of the larger drainage ways. The trees are not of merchantable size but are of value for firewood and posts.

The first permanent settlers in the area now included in Harlan County located in Republican Valley in 1870, and within the next few years settlement spread rapidly throughout the valleys and uplands. The early settlers came chiefly from Iowa, Illinois, Missouri, and other States to the east. The county was established and organized in 1871, and its boundaries have remained unchanged.

According to the 1930 Federal census the population is 8,957, all of which is classed as rural, and the density is 15.6 persons a square mile. The population is rather evenly distributed, although it is densest along the railroads and in the vicinity of towns. The same census reports that 95.4 percent of the inhabitants are native whites, 4.5 percent foreign-born whites, and 0.1 percent negroes. The people of foreign birth are principally from the Scandinavian countries and Germany. Alma, the county seat and largest town, located in the south-central part of the county, has 1,235 inhabitants. This town and Orleans, which has 985 inhabitants, are the main distributing centers and afford good markets for much of the surplus farm products. Smaller towns located along railroads furnish local markets for farm implements, supplies, and produce.

Transportation facilities are good. Main or branch lines of the Chicago, Burlington & Quincy Railroad cross the county in several directions, and all parts are within 9 miles of a shipping point. The public-road system is well developed. State and Federal highways roughly parallel most of the railroad lines, and several of them are gravel surfaced. County roads are of earth construction but are kept in good repair. All roads, except parts of the highways and some of the roads in the rougher sections, follow land lines. Cement bridges and culverts are common, even on the minor roads.

The county is well supplied with rural mail-delivery routes, telephones are in common use, and the public-school system is highly developed.

CLIMATE

The climate of Harlan County has wide seasonal extremes. The winters are rather long and cold, and the summers are very warm. The spring is usually cool with considerable precipitation, and the fall season is long, with moderate temperatures and only occasional periods of rainy weather. The climate is well suited to grain growing and livestock raising.

The average date of the last killing frost is May 4, and that of the first is October 2, which gives an average growing season of 151 days, ample for the maturing of all crops ordinarily grown. Killing frosts have been recorded as late as May 27 and as early as September 12. In the 20-year period from 1895 to 1914, there were five seasons when the last killing frost in spring was 10 or more days later than the average and four seasons in which the first in fall was 10 days or more earlier.

The precipitation is well distributed. Nearly 80 percent of the rain falls between April 1 and October 1, or the principal part of the growing season. In July and August the precipitation is frequently rather low, and evaporation during those months is usually accelerated by strong hot south winds which sometimes cause short droughts. However, as most of the soils are very retentive of moisture, total crop failures are rare.

The prevailing wind is from the southeast, except during winter when it is from the northwest. Strong winds are common, but tornadoes are rare.

Table 1, compiled from records of the United States Weather Bureau station at Alma, gives the normal monthly, seasonal, and annual precipitation.

TABLE 1—Normal monthly, seasonal, and annual temperature and precipitation at Alma, Harlan County, Nebr.

(Elevation, 1,942 feet)

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1907)	Total amount for the wettest year (1915)	Snow, average depth
	°F	°F	°F	Inches	Inches	Inches	Inches
December.....	27.4	70	-24	0.60	0.76	0.39	3.8
January.....	26.0	76	-29	30	22	28	3.0
February.....	28.8	82	-38	62	27	1.75	5.7
Winter.....	27.4	82	-38	1.52	1.25	2.42	12.2
March.....	39.7	97	-14	92	86	2.00	6.0
April.....	51.6	100	9	2.44	74	4.53	2.0
May.....	61.3	102	17	3.24	1.66	4.49	4
Spring.....	50.8	102	-14	6.00	3.20	11.02	8.4
June.....	71.6	108	30	3.47	4.18	9.82	0
July.....	76.5	111	44	3.20	33	6.04	0
August.....	75.4	107	37	3.32	1.14	7.84	0
Summer.....	74.5	111	36	9.99	5.65	23.70	0
September.....	66.7	105	21	2.18	1.71	1.37	0
October.....	54.8	95	5	1.50	40	34	8
November.....	40.2	82	-8	79	26	24	1.4
Fall.....	53.9	105	-8	4.47	2.37	1.95	2.2
Year.....	51.6	111	-38	22.58	12.53	39.09	22.8

AGRICULTURE

Prior to 1870 the area now included in Harlan County was inhabited principally by Indians. The land was covered with a luxuriant growth of prairie grasses. The first permanent settlers located along the larger streams where water and wood were easily obtained, but later settlement spread into the uplands.

Sod corn, potatoes, and garden vegetables, all of which were grown for home consumption, were the leading crops during the first few years. As settlement increased and conditions became more stable, wheat, oats, rye, and barley were grown. Ranching was followed to some extent but became important only in the rougher sections, as over most of the county larger returns were obtained from grain crops than from livestock raising.

The early agricultural development was somewhat retarded by lack of familiarity with local climatic and soil conditions, by the use of seed poorly adapted to the locality, by lack of markets and transportation facilities, and by insect pests and droughts. However, as the early settlers had the experience of farmers in counties to the east to draw on, they rapidly adjusted their farming practices to the requirements of the new country. The establishment of railroads gave added impetus to agricultural development, and by 1890 a large proportion of the land was under cultivation.

The value of all crops produced in Harlan County in 1929³ was \$2,790,289. Surplus dairy products were produced to the value of \$360,509 and poultry and eggs to the value of \$294,884. The total value of all domestic animals on farms on January 1, 1929, was \$2,487,770.

During 1929, about 56 percent of the land was under cultivation, 1,200 acres of which was irrigated. About 40 percent was in range or pasture land, about 1.6 percent was in woodland, and about 0.6 percent was occupied by water. The remainder was not classified, but was probably included in highways, incorporated places, and farm-building sites.

Table 2 gives the acreage and production of the principal crops and shows the general trend of agriculture during the last 50 years. Table 3 gives the number and value of domestic animals on farms in 1909, 1919, 1924, and 1929. These tables are compiled from the Federal census reports.

TABLE 2 — *Acreage and production of principal crops in Harlan County, Nebr., in stated years*

Crop	1879		1889		1899	
	<i>Acres</i>	<i>Bushels</i>	<i>Acres</i>	<i>Bushels</i>	<i>Acres</i>	<i>Bushels</i>
Corn.....	15,507	392,649	58,927	2,037,872	79,266	2,085,050
Wheat.....	16,284	120,594	19,083	232,815	35,683	225,120
Oats.....	985	16,027	10,011	222,117	8,733	121,600
Barley.....	1,045	11,149	645	14,554	724	5,500
Rye.....	995	9,422	2,248	23,513	2,076	16,060
Potatoes.....		17,251	1,027	88,259	712	56,026
		<i>Tons</i>		<i>Tons</i>		<i>Tons</i>
Tame hay.....	17,936	10,644	19,840	24,199	10,016	28,008
Alfalfa.....					7,617	23,990
Clover.....					17	55
Wild, salt, and prairie grasses.....					14,568	12,570
Coarse forage.....					2,424	4,889

³ Data from Nebraska agricultural statistics

TABLE 2.—*Acreage and production of principal crops in Harlan County, Nebr., in stated years—Continued*

Crop	1909		1919		1929	
	<i>Acres</i>	<i>Bushels</i>	<i>Acres</i>	<i>Bushels</i>	<i>Acres</i>	<i>Bushels</i>
Corn.....	81,717	1,039,859	88,357	2,700,367	118,639	2,310,380
Wheat.....	64,225	741,321	81,548	1,143,984	54,812	634,927
Oats.....	13,331	259,005	4,875	150,472	6,095	204,272
Barley.....	370	5,402	3,449	74,338	3,352	80,935
Rye.....	301	2,863	839	9,799	126	1,456
Potatoes.....	723	43,147	299	11,440	536	47,923
<i>Tons</i>						
Tame hay.....	15,187	25,050	8,758	18,050	118,670	120,528
Alfalfa.....	12,877	22,640	6,190	14,172	6,346	12,360
Clover.....	49	53	110	169	455	453
Wild, salt, and prairie grasses.....	15,447	11,211	13,488	12,081	8,710	3,943
Coarse forage.....	2,840	5,107	10,824	25,364	4,047	-----

¹ All hayTABLE 3.—*Number and value of domestic animals on farms and ranges in Harlan County, Nebr., in 1910, 1920, 1925, and 1930*

Kind of animal	1910		1920		1925		1930	
	<i>Number</i>	<i>Value</i>	<i>Number</i>	<i>Value</i>	<i>Number</i>	<i>Value</i>	<i>Number</i>	<i>Value</i>
Horses.....	10,134	\$1,007,715	8,917	\$658,636	7,418	\$396,865	7,161	\$358,682
Mules.....	1,571	178,671	1,612	169,645	1,738	119,104	1,517	100,436
Cattle.....	21,511	493,101	28,017	1,270,822	23,162	704,554	23,655	1,161,382
Sheep.....	1,017	4,634	708	6,993	1,505	16,190	2,436	18,120
Goats.....	7	27	12	72	41	246	63	336
Swine.....	27,600	230,670	23,414	464,971	28,070	377,672	35,282	463,093
Poultry.....	92,992	42,555	115,769	103,093	129,986	96,180	121,174	159,982

Corn, winter wheat, oats, wild hay, alfalfa, and sorghum forage, ranking in acreage during most years in the order named, are the leading crops. Minor crops include barley, sweetclover, potatoes, and garden vegetables.

Table 4, compiled from the 1929 Nebraska agricultural statistics, shows the average yields of the most important crops during the 10-year period 1916 to 1925, inclusive; the average yields in 1929; and the approximate percentage of the cultivated land devoted to each crop in 1929.

TABLE 4.—*Data concerning the most important crops in Harlan County, Nebr.*

Crop	Average acre yield, 1916-25, inclusive		Average acre yield, 1929		Approximate amount of cultivated land devoted to each crop in 1929
	<i>Bushels</i>	<i>Bushels</i>	<i>Bushels</i>	<i>Percent</i>	
Corn.....	19 7	19 0	61 0		
Winter wheat.....	11 4	12 0	25 8		
Oats.....	25 9	33 0	3 3		
Barley.....	29 0	29 0	1 6		
<i>Tons</i>					
Alfalfa.....	2 61	2 5	2 6		
Sorghum forage.....	2 2	2 2	2 0		
Sweetclover.....	92	9	1 0		

The 1930 Federal census reports show that 94.3 percent of the land in the county is in farms and that 69.6 percent of the farm land is improved. The majority of farms range from 50 to 500 acres in size, the average being 275.6 acres.

Owners occupy 50.2 percent of the farm land, renters 49.6 percent, and managers 0.2 percent. The proportion of tenant-operated farms increased greatly between 1900 and 1920 but has decreased slightly within the last decade. Both the cash and share systems of rental, or sometimes a combination of the two, are followed. The share system is most popular, 86 percent of the land being rented on shares in 1929. Under this system the owner receives one third of the grain delivered to the nearest market, and from 50 cents to \$2 an acre for the pasture land and building site. All seed, labor, and machinery is furnished by the tenant. When alfalfa land is rented on shares, the owner usually receives half the hay stacked in the field. Under the cash system, the tenant pays from \$3 to \$6 an acre for the use of the land including the pasture areas. Most of the land rented for cash is in the larger valleys.

The farm buildings are, in general, well painted and kept in good repair, and many of the houses are equipped with modern conveniences. In 1929, 133 of the farmhouses had lighting systems, 340 had modern water systems, and 453 had radios. The farms are fenced mainly with barbed wire, though some are inclosed with hog-tight woven-wire fencing. Four- and six-horse teams perform most of the farm work, although the lightweight tractor is being used. There were 252 tractors, 120 trucks, and 1,167 automobiles on the farms in 1929. The farm machinery is of the most modern and labor-saving types. There were 77 grain threshers, 14 wheat combines, and 922 cream separators in the county in 1929. Many farms are equipped with corn binders, corn huskers, and chicken incubators. The more expensive farm machinery is sheltered.

In general farm laborers are plentiful except during small-grain harvest, when good help is often scarce. Monthly wages range from \$30 to \$50, with board and lodging, and day labor commands from \$2.50 to \$3.50. Wheat is threshed for 6 or 8 cents a bushel and oats for 3 or 4 cents. Corn shuckers usually receive from 6 to 8 cents a bushel. Many farmers hire help by the year in order to insure an adequate supply at critical periods.

Livestock and its products rank next to farm crops as a source of income, and the raising and fattening of cattle and hogs are among the most important agricultural industries.

The quality of the beef cattle in general is very good. The animals as a rule are of grade stock, but most of the herds are headed by a purebred Hereford or Shorthorn bull. Most of the beef cattle are raised locally. A few farmers annually ship in cattle for summer grazing, and many feeders purchase cattle from the Omaha or Kansas City markets for winter fattening. The animals are fed corn and alfalfa for a period ranging from 60 to 90 days, after which they are shipped to the most favorable market. Most of the fattened cattle are produced in the larger valleys where there is an abundance of alfalfa to balance the corn ration.

The dairy industry is of minor importance; and although most farmers keep from 5 to 10 milk cows, no farm is devoted exclusively to dairying. Most of the milk cows are of mixed beef and dairy

breeding, and there are a few purebred Holstein-Friesian herds in the vicinity of the larger towns. The greater number of farmers sell their surplus cream to local buyers. A large cooperative creamery is maintained at Orleans, where most of the surplus dairy products are handled.

Nearly every farmer raises a few hogs each year, and many have herds of several hundred. Poland China, Hampshire, and Duroc-Jersey are the leading breeds. A few farmers have purebred herds, but most of the animals are grade stock. Hogs are usually fattened on corn, either in feeding yards or by turning them into the fields and allowing them to hog down the corn in the fall. It is common practice to add alfalfa to the ration during the summer, and many farmers allow the animals to run in the alfalfa fields until the third crop is cut. Hog cholera has been very destructive in the past, but losses from this disease have been largely eliminated during recent years by attention to sanitation and vaccination.

A few sheep are raised in the rougher sections, but the sheep industry consists chiefly of fattening ewes and lambs imported from the Omaha or Kansas City markets and is of minor importance.

Most farmers raise their own work animals and occasionally have a team to sell. The horses are of heavy-draft type, ranging in weight from 1,300 to 1,600 pounds. The stallions are purebred, and most of the mares are grades. A few mules are raised. The increased use of tractors has made horse raising unprofitable during the last few years.

Poultry provides an important source of income on nearly all farms, and, in addition to chickens, many farmers raise ducks, geese, turkeys, and guinea fowl. No farmer devotes his time entirely to the poultry industry. However, the demand for poultry products has been increasing during recent years, and the poultry industry is receiving considerable attention. The principal breeds of chickens are Plymouth Rock, Leghorn, and Rhode Island Red. All the poultry products are sold in the local towns.

Soil management and cropping practices are similar to those practiced throughout south-central Nebraska. Corn, the most important crop, is planted in May, the greater part being planted with a lister and the rest planted in checkrows. The former method requires no seed-bed preparation beyond that furnished by the lister, and corn thus planted is thought by most farmers to be more drought resistant than checkrowed corn. The corn crop is cultivated 3 or 4 times during the season, mostly with 2-row cultivators. The last cultivation is usually given early in July, after which the crop is "laid by" and receives no further attention until harvest.

Corn matures in September or early in October, depending on the season. The greater part of it is husked from the standing stalks, after which cattle and horses are pastured in the fields during the winter. On some farms, a part of the corn is cut for winter fodder. On farms equipped with silos, corn from 15 to 20 acres is cut each year for silage, usually with a corn binder when the grain is still in the dough stage, and it is hauled to the silage cutter while the stalks are green. Many farmers annually fence off a few acres of unhusked corn for fattening hogs and cattle, thereby saving part of the expense of husking.

The chief varieties of corn are Reid Yellow Dent, Iowa Silvermine, and Calico, but careful seed selection is not followed. Some farmers purchase seed outside the county, but, as a rule, this seed does not yield so high as a good type of well-adapted local seed. Extension service agronomists at Lincoln recommend the selection of seed from corn known to have been grown in the locality and known to have become adapted to local climatic and soil conditions. Corn usually follows small grain or alfalfa in rotations, although it is often grown on the same land many years in succession, with only a slight decrease in yields.

Practically all the wheat grown is of the winter varieties, chiefly Turkey, Kanred, and Nebraska No. 60. The last-named variety is being grown more extensively each year, as it contains the good features of the Turkey, from which it was selected as a pure strain, and yields about 10 percent higher than that variety. The land to be used for wheat is usually plowed and harrowed during late summer, and the seed is planted with a press drill late in September. Some seed is drilled in between the corn rows early in the fall, and the crop usually makes a good growth before killing frosts occur. It remains dormant during the winter, resumes growth in early spring, and usually matures early in July. It is generally cut with a header and stacked for threshing, although many farmers harvest their wheat with a combine. No definite crop rotation is followed, but wheat is usually grown on the same land two or more years in succession, followed by barley or oats for one year, then corn or alfalfa for several seasons.

Wheat yields are sometimes reduced by stinking smut which distorts the kernels, prevents their normal growth, and gives the grain an offensive odor. This form of smut may be controlled by mixing the seed, before planting, with copper-carbonate powder at the rate of 2 or 3 ounces of the powder to a bushel of grain.⁴

Oats are not so profitable as corn or wheat. However, the crop is very important as feed for work animals and as a step in the rotation between corn and wheat. Oats are planted and harvested in the same manner as wheat, but the land is prepared and the grain planted in spring instead of fall. Kherson, Swedish Select, and Nebraska 21, which is a selection of Kherson, are the leading varieties. Nebraska 21 is considered the best variety, as it has a short stiff stem, matures early, and yields somewhat higher than other varieties. A few farmers import seed from other sections, but the common custom is to clean a sufficient quantity of seed from the previous crop. Very few oats are sold. The straw has a higher feeding value than that of most small-grain crops, and it is fed to horses and cattle.

Smut sometimes lowers oat yields during prolonged periods of rainy or cloudy weather. The injury from this source, however, can be controlled by killing the smut spores on the seed before planting. This may be done by spraying the seed, the day before planting, with a solution consisting of equal parts of formaldehyde and water. One quart of solution is sufficient for treating about 40 bushels of oats.⁵

Barley is of minor importance. The common 6-rowed smooth-bearded varieties are regarded as superior for Nebraska conditions and have proved more productive than the beardless varieties. The

⁴ STEWART, P. H., and GROSS, D. L. SMUT CONTROL IN CEREALS. Nebr. Agr. Col. Ext. Circ. 132, 13 p., illus. 1929

⁵ STEWART, P. H., and GROSS, D. L. Op cit

land to be used for barley is prepared early in spring. The seed is planted and the crop harvested in the same manner as oats. Practically all the barley is used as hog feed.

Alfalfa is the leading hay crop. The varieties grown are among the most hardy obtainable, including Common, Grimm, and Cossack, all of which are resistant to winter-killing. The seed is usually sown in April or early May, and thorough seed-bed preparation is important in obtaining a stand. Early plowing, followed by sufficient disking, harrowing, and possibly rolling, to control weed growth and compact the soil, is desirable in most places. The best results are obtained by planting the seed after the first heavy rain in spring. The standard seeding rate is from 10 to 15 pounds of good seed to the acre. Pure certified seed should be used. Planting with a press drill nearly always results in higher yields than broadcasting the seed. Drilled seed should not be planted deeper than 1 inch. When the seed is broadcast it is usually covered with a harrow.

A stand of alfalfa is usually allowed to remain from 3 to 5 years on the uplands and from 6 to 8 years on alluvial lands, or as long as it remains profitable. A field is rarely frozen out. The crop is usually cut three times during the summer, and occasionally a fourth cutting is obtained. Yields range from 1½ to 6 tons an acre each year, depending on the location of the field and the season. The common practice is to stack the hay in the field and haul it to the feed lots as needed. Most of it is fed to cattle and hogs. Many farmers run hogs in the alfalfa fields during summer. Cattle, however, are seldom allowed to graze for long periods on green alfalfa, on account of the danger of bloat.

A large acreage is devoted to the production of wild hay, some of which is cut from the numerous depressions in the northeastern part of the county. However, most of this hay is produced on poorly drained areas in the bottom lands and on the sloping upland areas which erode badly if not protected by a sod covering. The hay produced in poorly drained situations is rather coarse, but that from the upland slopes is of excellent quality, consisting chiefly of bluestem and wheatgrass. Most of the hay is either stacked in the fields or stored in barns for winter feeding, and a small quantity is baled.

Sweetclover, although still of minor importance, is being grown more extensively each year, especially throughout the uplands. Sweetclover seed is usually planted in early spring, either late in March or early in April. Land to be used for this crop is prepared in the same manner as that to be used for alfalfa. The seed is generally sown broadcast and covered with a harrow. Some seed is planted with a press drill, which usually insures a more uniform stand. From 20 to 30 pounds of unhulled seed is ordinarily used, or about half as much when hulled or scarified seed is used.⁶ The plant is a biennial and dies at the end of the second year, after producing seed. It is used chiefly for pasture and to some extent for hay and seed. When hay is desired, the crop is usually cut during the first year before the growth becomes coarse and weedy. The second year the crop may be allowed to mature and reseed itself, or it may be cut with a binder and threshed for seed. The permanence of a sweetclover stand depends entirely on its ability to reseed, and

⁶ STEWART, P. H., and GROSS, D. L. SWEETCLOVER IN NEBRASKA. Nebr Agr Col Ext Circ. 122 [16] p., illus. 1923

most farmers take care during the second year not to graze so closely as to prevent the maturity of enough of the crop to reseed the land.

Sweetclover has an unusually wide adaptation. It thrives on both comparatively wet and dry soils and on soils of either light or heavy texture. It is very valuable for soil improvement. Most farmers on the uplands and some on the alluvial lands consider it more satisfactory for this purpose than alfalfa. It is adapted to shorter rotations and will probably increase the producing power of the soil as fast as that crop. The roots are large, and they decay rapidly at the end of the second year's growth. The crop not only adds organic matter to the soil, but, in common with other legumes, has the power of fixing atmospheric nitrogen in the nodules on its roots. It is a good soil binder and is especially valuable on the steeper valley slopes where erosion is severe.

Sorghum, the chief forage crop, is grown on most of the upland farms. The yields range from 1 to 5 tons an acre, depending on the season. Sorghum belongs to a group of plants that become temporarily dormant during dry periods, and it is very drought resistant as well as extremely productive. The best quality of feed is produced if the crop is cut when the earliest heads begin to mature. Most of it is fed with corn and oats. Its feed value compares favorably with any of the wild hays. Black Amber, Sumac, and Early Orange are the most common varieties grown.

No commercial fertilizer is used. Barnyard manure is applied on some of the sandy bottom-land soils. Very little soil enrichment of any kind is used in the uplands, partly because the soils are naturally very fertile and partly because manure often causes the crops to produce a rank vegetal growth in early spring and leaves them poorly prepared to withstand the hot dry weather of middle and late summer.

SOILS AND CROPS

Grain and livestock are the chief sources of revenue in Harlan County. As previously mentioned, about 56 percent of the land is under cultivation and about 40 percent is in range and pasture. The importance of livestock as a source of revenue is obviously owing in large measure to the high percentage of grazing land.

Corn is the leading crop, principally because it is needed as feed for livestock but partly because it can be used as a cash crop in years when cattle and hog fattening are unprofitable. It occupied about 61 percent of the cultivated land in 1929. Much corn is sold, especially in seasons of unusually high precipitation when the corn yields exceed the requirement of this grain for feed. Wheat, however, is the chief cash crop and was grown on about 26 percent of the cultivated land in 1929. Of the remaining cultivated crops, tame hay, principally alfalfa, occupied about 4.5 percent of the farmed land, oats about 3 percent, sorghum forage about 2 percent, and barley about 1 percent. The remainder is used for millet, Sudan grass, rye, potatoes, and other feed and sustenance crops.

Although corn greatly exceeds wheat in acreage, it is not so well adapted to the prevailing climate, particularly the precipitation, and corn yields are much more variable than those of wheat. Were it not for the fact that corn is so necessary for feed, its acreage would undoubtedly be reduced to the advantage of that devoted to wheat.

The grain and tame-hay crops are grown rather indiscriminately on all the cultivated land, but the proportional acreage devoted to any particular crop differs somewhat in different sections. Throughout the uplands the proportional acreage devoted to corn is greater in the southern than in the northern half of the county, and the reverse is true of the proportional acreage devoted to wheat. This corn and wheat relationship is probably owing largely to the fact that nearly level land, on which most of the wheat is produced, is less extensive in the southern than in the northern part of the county, and more difficulty is experienced in using wheat-planting and harvesting machinery than corn machinery. A larger percentage of the bottom lands than of the uplands is used for alfalfa, because this crop requires more moisture for its optimum growth than is supplied by the normal precipitation of the region. It naturally gives the highest returns when grown in localities where the precipitation is supplemented by run-off from higher levels or where the water table lies at a rather slight depth. All small-grain crops are grown more extensively on the uplands and terraces than on the bottom lands, because the high moisture content in the latter situations usually causes these crops to produce a rank vegetal growth at the expense of the grain. Other than wheat, however, small-grain crops are of minor importance. The oat acreage is determined chiefly by the requirements of work animals and to some extent by the increased facility oats give as a step in the rotation between corn and wheat. Barley and sorghum forage, which are produced principally in the uplands, are grown only in small fields to supplement the feed supply.

The cultivated soils of the county are naturally productive. Differences occur in the yields and crop adaptabilities of the different soils, but these are owing more to differences in topographic features, particularly the slope of the land and its elevation with respect to surrounding areas or to the underlying water table, than to differences in the soils themselves.

Harlan County is in the prairie region of the United States, and all the soils that are not severely eroded or have not developed from recently deposited and light-colored parent materials have dark topsoils, owing to an abundance of black organic matter derived from decayed grass roots. In addition to their dark color, most of the soils are characterized by an abundance of lime at slight depths and by friable topsoils and subsoils which are easily penetrated by air, moisture, and crop roots.

The black organic matter in the topsoils is one of the most valuable soil assets from the point of view of crop production. It increases the water-holding capacity of the soils, which is a very important feature in a region as far west as Harlan County where the precipitation is rather low and most of it must be retained by the soils if farming is to be profitable, especially in the uplands. The organic matter also assists in maintaining uniform soil temperature, good tilth and a favorable nitrogen supply, all of which are highly important in corn production.

The uncultivated soils of the county are, as a rule, very low in organic matter. They are most extensively developed on steep valley slopes in the uplands, where rapid surface run-off prevents much accumulation of decayed grass remains and where the land surface is unfavorable for the use of farm machinery. However, some uncul-

tivated soils occupy poorly drained upland depressions, in which the topsoils are very thin and have been rather severely leached of their organic constituents. Throughout the bottom lands and terraces the land surface is nearly level, and, although differences in the organic-matter content of the soils is reflected in crop yields, the uncultivated land lies chiefly in poorly drained spots or in local areas of recently deposited loose gray sand.

Although the soils of the county differ in their producing powers and adaptabilities to crops, they may be placed in groups, each of which includes soils that are fairly uniform in agricultural value and are used for some particular crop or crops more extensively than soils belonging to another group. This does not mean that a crop is grown only on a particular soil or group of soils. It may be grown on all of them but, as a result of its adaptability to the profile features, the topography, or the drainage of a certain soil, is the dominant crop on that soil. Four groups of soils, based on soil characteristics and other features that affect agriculture, are recognized, namely, well-drained upland and terrace soils, excessively drained upland soils, poorly drained upland soils, and bottom-land soils.

In addition to differences in drainage, the soils differ in other characteristics which affect agriculture, such as surface features, moisture content, and tendency to erode. None of the groups is confined to any particular section of the county, although some of the soils in each group are very local in their distribution.

In the following pages the individual soils of the different groups are described, and their crop adaptations are discussed; the soil map accompanying this report shows the distribution of the soils; and table 5 gives their acreage and proportionate extent.

TABLE 5.—*Acreage and proportionate extent of soils mapped in Harlan County, Nebr.*

Type of soil	Acre	Per- cent	Type of soil	Acre	Per- cent
Holdrege silt loam.....	184, 192	50 1	Nuckolls silt loam, eroded phase....	7, 168	2 0
Hastings silt loam.....	4, 224	1 1	Butler silt loam.....	1, 664	5
Hall silt loam.....	17, 344	4 7	Scott silty clay loam.....	1, 408	4
Hall silt loam, high-terrace phase....	6, 848	1 9	Sarpy loamy sand.....	9, 280	2 5
Hall very fine sandy loam.....	12, 160	3 3	Sarpy very fine sandy loam.....	3, 264	9
Hall very fine sandy loam, high- terrace phase.....	2, 368	6	Lamoure silt loam.....	6, 208	1 7
Bridgeport very fine sandy loam....	4, 864	1 3	Cass very fine sandy loam.....	5, 824	1 6
Colby silt loam.....	100, 544	27 4	Total.....	367, 360	-----

WELL-DRAINED UPLAND AND TERRACE SOILS

The soils of this group occupy 63 percent of the county, and about 94 percent of them is cultivated land. One or another of them occurs in nearly all parts of the county, except the bottom lands. Their surface relief ranges from nearly level to gently rolling, and all of them have adequate surface and subsoil drainage. The group includes soils of the Holdrege, Hastings, Hall, and Bridgeport series. Soils of the first two series named occupy upland positions, and soils of the last two are on terraces.

The Holdrege, Hastings, and Hall soils have developed from the gray limy and floury loess formation which covers most of the county. Their topsoils range from 8 to 16 inches in thickness, are well supplied with organic matter, and are very dark. Their subsoils are lighter

colored, being composed largely of loose floury silt, although the subsoil in the Hastings soils has accumulated considerable clay, especially in the upper part. The Bridgeport soils have developed from a rather recently deposited mixture of loess and sand and are fairly light colored throughout.

All the soils of this group are friable, have high moisture-holding powers, and, below a depth ranging from 30 to 40 inches, contain an abundance of lime. They are well adapted to all crops commonly grown in the region, and, owing to their large total extent, are the most important general-farming soils in the county.

The upland soils of the group are not quite so productive, as a rule, as the terrace soils, because the precipitation received by them is not supplemented by run-off from higher levels as it is on the benches. None of the soils of the group produces as high yields, especially of corn and alfalfa, as some of the bottom-land soils, but all of them are adapted to a wider variety of crops than those soils and produce higher yields of all crops than any upland soil not belonging to the group.

The proportional acreages devoted to the different crops on soils of this group differ only slightly from those given for the cultivated land of the county as a whole. Corn is grown on about 58 percent of the area occupied by these soils, wheat on about 28 percent, oats on about 4 percent, tame hay and sorghum each on about 3 percent, and barley on about 2 percent. The remainder of the area occupied by soils of this group is included principally in small fields of rye, millet, Sudan grass, and potatoes.

Holdrege silt loam.—Holdrege silt loam is the most extensive soil in Harlan County. It occupies all the nearly level or gently rolling well-drained parts of the uplands wherever erosion is not severe. It has developed from the light-gray limy and silty loess formation, and its surface in most places lies near the level of the old loess plain.

The topsoil, which ranges from 14 to 16 inches in thickness, is very dark grayish-brown mealy silt loam. The dark color is the result of an abundance of well-decomposed organic matter which constitutes nearly 3 percent by weight of the topmost 6 inches of the soil. The upper subsoil layer is grayish-brown silt loam. It is a trifle heavier than the topsoil, owing to a slightly higher clay content, but it is loose and friable throughout. The lower subsoil layer, beginning at a depth of about 28 inches below the surface of the ground, is very light grayish-brown floury silt. The topsoil and upper subsoil layer have been leached of their lime, but this constituent has accumulated in the lower part of the subsoil, making that layer more limy than any of the layers above or below. The limy layer is commonly known as the lime zone. The parent light-gray limy and floury loess occurs at a depth of about 4 feet.

This soil, although remarkably uniform in its characteristics throughout the area of its occurrence, presents a few variations. On the broader, more nearly level divides in the north-central and north-eastern parts of the county, the topsoil is a little thicker and darker, the subsoil a little denser, and lime lies at a slightly greater depth. However, these differences are scarcely noticeable except through close observation and do not seem to have any influence on the agricultural value of the soil. They occur only in the more nearly level areas and are undoubtedly caused by unusually slow surface drainage

which has allowed more of the precipitation to enter the ground, thereby increasing the growth and decay of vegetation, the translocation of clay into the subsoil, and the depth to which the lime has been leached.

In the more rolling areas of the soil, especially in the vicinity of the Colby soils, where the relief has allowed more rapid run-off than usual, erosion has somewhat thinned the topsoil and lime lies a little nearer the surface of the ground than in the more nearly level parts.

Holdrege silt loam is highly retentive of moisture and is easily maintained in good tilth. The soil throughout is sufficiently porous to allow good aeration, easy root penetration, and the free upward and downward movement of soil moisture. Lime, although not abundant in the topsoil, is present in sufficient quantities to prevent excessive leaching of the organic matter and other plant foods and to prevent the soil from becoming sour or acid. The lime in the subsoil is within easy reach of crop roots.

This is one of the most productive upland soils in the region. It is adapted to all crops suited to the climate and because of its large extent is the most important soil in the production of the agricultural products on which the prosperity of the county is dependent. It does not produce quite such high yields, especially of corn, as some of the upland soils in eastern Nebraska and throughout Iowa, where the rainfall is greater than in Harlan County, but the great demand for corn as a feed for livestock necessitates using the soil chiefly for this crop. It is one of the most productive wheat soils in the central prairie States. Alfalfa, provided a good stand is obtained, gives good returns for three or four years because it is able to obtain moisture from great depths. However, when the deep-seated moisture supply is exhausted, alfalfa yields decline, as the crop in this part of Nebraska is unable to make good growth on soils receiving moisture supplied by seasonal precipitation alone, and it is of minor importance on any upland soil in the county. Yields of wheat fluctuate less than those of corn, because wheat matures early in the summer, usually before the moisture stored in the soil during the winter and spring is exhausted. Oats, rye, and barley also yield rather consistently; but as wheat is the chief cash crop, it is grown much more extensively than other small grains.

In seasons of normal precipitation the average yield of corn is about 20 bushels an acre; of wheat, 12 bushels; of oats, 24 bushels; of barley, 26 bushels; and of rye, 15 bushels. In normal years, alfalfa during the first 3- or 4-year cropping period yields about 2 tons of hay an acre each season. In seasons of unusually high precipitation, yields of all crops are from 50 to 75 percent higher than in normal years, and in dry seasons corn and alfalfa yields are especially low.

Hastings silt loam.—Hastings silt loam occupies several slightly depressed bodies throughout the more nearly level Holdrege areas in the northeastern and north-central parts of the county. The largest area, comprising about 2½ square miles, is north of Ragan and extends into the southern part of Phelps County. The other bodies are much smaller. As a rule, areas of this soil have no surface-drainage outlets, but most of them include bodies of lower-lying Scott or Butler soils, into which the surplus surface moisture slowly drains after heavy rains.

This soil, although not so well drained as the Holdrege soil, is not subjected to so much excess moisture as the Scott or Butler soils. Its topsoil, which is well supplied with organic matter, is very dark grayish-brown friable silt loam from 16 to 18 inches thick. The upper part of the subsoil, to a depth of about 30 inches, is grayish-brown moderately compact silty clay loam. However, it is not dense or claypanlike and is easily penetrated by air, moisture, and crop roots. The lower subsoil layer is light-gray or almost white loose floury silt. Lime is abundant below a depth of about 4 feet. This soil differs from Holdrege silt loam in that its topsoil averages a trifle thicker, its upper subsoil layer is more compact, and the layer in which lime is abundant lies deeper than in that soil. The upper subsoil layer is browner and much less compact than the corresponding layer in any area of the Butler or Scott soils.

The same crops are grown on Hastings silt loam as on Holdrege silt loam, and yields on the Hastings soil average about 10 percent higher than on the Holdrege, probably because of the slightly more favorable moisture conditions. However, on account of its small extent, the Hastings soil is of minor agricultural importance.

Hall silt loam.—Hall silt loam is the most extensive terrace soil. It occurs in narrow, though fairly continuous strips, or in bodies of various sizes and shapes, in nearly all the major valleys. The largest developments are along Republican River and Sappa, Prairie Dog, Spring, Turkey, and Deep Creeks.

The surface relief ranges from nearly level to very gently undulating. The soil lies from 10 to 15 feet above the stream channels and is not subject to overflow, as it is well drained throughout.

This soil, where typically developed, is identical in its characteristics with Holdrege silt loam, but it differs from that soil in topographic position. As mapped in Harlan County, however, it includes more variations than the Holdrege soil. Over much of its area two soils are developed, one above the other. The upper soil in few places exceeds 40 inches in thickness. It has a dark topsoil and in most places is characterized by a light-colored limy subsoil. The lower (buried) soil is similar to Holdrege silt loam in character and thickness. Locally, the upper soil is only a foot or so thick and is composed entirely of dark-colored friable silt loam which rests directly on the topsoil of the lower (buried) soil, making that layer appear much thicker than the normal surface soil of the soils of the region. In some places, usually adjacent to areas of Bridgeport soils, the topsoil to a depth of 4 or 5 inches is slightly lighter in color and coarser in texture than typical, approaching a very fine sandy loam.

All crops grown on Holdrege silt loam do well on Hall silt loam. Most of the Hall soil is used for corn, with wheat ranking next in acreage. In seasons of normal precipitation corn yields are from 20 to 30 percent higher on Hall silt loam than on Holdrege silt loam, and in dry years they are often 50 percent higher. In average years wheat yields from 10 to 15 percent more than on the Holdrege soil. Alfalfa occupies a somewhat larger acreage in proportion to other crops on the Hall than on the Holdrege soil, and it usually yields about 3 tons of hay an acre each season.

The higher yields obtained on the Hall than on the Holdrege soil are owing more to differences in the moisture supply of the two soils

than to soil differences. The Hall soil naturally receives some water in the form of run-off from the higher-lying Holdrege soil, which gives it a more favorable moisture supply.

Hall silt loam, high-terrace phase.—As its name implies, this soil occupies the higher stream terraces. It occurs chiefly in the Republican River Valley, although it is also developed in the valleys of Sappa and Prairie Dog Creeks. Its surface is nearly level and is from 10 to 20 feet above that of the lower-lying Hall soils.

Where typically developed, soil of this phase does not differ noticeably in any soil characteristic from Holdrege silt loam. It is subject to the same variations as Hall silt loam of the lower terraces, but the variations are much less extensive than in that soil.

This soil produces slightly higher yields of most crops common to the region than Holdrege silt loam. It equals the lower-lying terrace soils in wheat yields but does not produce quite such high yields of corn and alfalfa as do those soils. Alfalfa, in fact, does not yield much higher on the high-terrace phase of Hall silt loam than it does on Holdrege silt loam, probably because the water table in both soils is beneath the reach of alfalfa roots.

Hall very fine sandy loam—Hall very fine sandy loam is similar to Hall silt loam in all soil characteristics, except that it contains a little more very fine sand in the surface layer. It is subject to the same variations as Hall silt loam and occurs on similar terrace levels, but it is a little less extensive than that soil.

This soil is as well adapted to, and as productive of, all crops common to the region as Hall silt loam. In fact, the farmers recognize no differences in the producing powers or crop adaptabilities between the two soils, and both are regarded with equal favor for general farming. Practically all the Hall very fine sandy loam is under cultivation.

Hall very fine sandy loam, high-terrace phase—This soil occupies the same terrace levels as Hall silt loam, high-terrace phase, but it is much less extensive than that soil. Most of it is included in one body, comprising about 3 square miles, southeast of Stamford.

This soil is similar in all characteristics to typical Hall very fine sandy loam, and, except for the slightly higher sand content of its topsoil, is similar to Hall silt loam. Practically all the land is under cultivation. The same crops are grown as on the high-terrace phase of Hall silt loam, and yields are similar to those obtained on that soil. Owing to its small extent, land of this phase is of little agricultural importance.

Bridgeport very fine sandy loam.—Bridgeport very fine sandy loam has developed from a rather uniform mixture of fine sands and silt deposited near the base of upland slopes or on gently sloping terraces, partly as colluvial material and partly as sediments left by the streams when they were flowing at higher levels. It occurs on the same terrace levels as Hall silt loam and Hall very fine sandy loam, but it is much less extensive than those soils. Most of it lies on the north side of Republican River, the largest area comprising about 800 acres west of Orleans. A slightly smaller body is south of Alma. The few remaining areas are much smaller.

The outstanding characteristic of this soil is its light color and uniform character to a depth ranging from 3 to more than 4 feet.

The soil is composed largely of grayish-brown friable very fine sandy loam. In most places the topmost 6 or 8 inches are much darker than the rest of the soil, in many places being dark grayish brown, owing to a comparatively large content of organic matter. However, it is not well supplied with this material and is nowhere so dark as the surface layer in the Hall soils. In most places lime occurs within a depth of 3 feet and in many places within a few inches of the surface of the ground.

The soil profile, although almost uniform from top to bottom, varies considerably from place to place. In numerous localities it contains large quantities of the fine and medium grades of sand, both in the topsoil and subsoil. In a few places the silt content is unusually large, and undoubtedly numerous small areas of Bridgeport fine sandy loam and Bridgeport silt loam are included with the very fine sandy loam. Locally the soil is underlain at a depth ranging from 1 to 3 feet by a buried dark-colored soil which resembles Hall silt loam in all characteristics. These variations, although rather numerous, are of little agricultural importance and are not shown on the accompanying map.

Owing to its lower organic-matter content, Bridgeport very fine sandy loam is not able to retain such large amounts of moisture as the Hall soils and does not have such a large nitrogen supply as those soils. These deficiencies, although reflected in slightly lower yields than are obtained on the darker terrace soils, are not sufficiently pronounced to greatly reduce the agricultural value of the land. Most farmers consider Bridgeport very fine sandy loam as only slightly inferior to Hall silt loam for general farming, and it is considered superior to Holdrege silt loam because of its more favorable position for the accumulation of moisture. Practically all the land is under cultivation and is used for the same crops as are grown on other terrace soils of the county.

EXCESSIVELY DRAINED UPLAND SOILS

The group of excessively drained upland soils includes only two soils, Colby silt loam and an eroded phase of Nuckolls silt loam, but they occupy 29.4 percent of the total area of the county. These soils occur principally on steep valley slopes along the numerous drainage ways throughout the uplands and are also mapped locally on sharp crestlike divides and on some of the narrow canyon floors. They have developed from fine-textured limy and floury loess but occur only where erosion has been especially severe. The greater part of the area occupied by them is topographically unsuited to cultivation, about 92 percent being used for pasture and about 5 percent for native-hay land. Most of the hay is obtained on the narrow canyon floors.

Owing to the rapidity of the surface run-off, the topsoils have been unable to retain much organic matter and are prevailingly light in color. Few of them exceed 6 inches in thickness, and over much of the area occupied by soils of this group they have been removed and the parent geological formations are exposed.

The cultivated land in these soils is confined to a few of the more gradual slopes where the topsoils have accumulated the largest quantities of organic matter, and it is used almost entirely for corn. The soils are composed largely of silt and are highly retentive of moisture,

but yields on them, even in the most protected situations, are much lower than on the well-drained upland and terrace soils, because less of the precipitation sinks into the ground for crop use.

Colby silt loam.—Colby silt loam occupies 93.2 percent of the area included in this group and 27.4 percent of the total area of the county. It has developed from light-gray limy and floury silt similar to that underlying the Holdrege and Hastings soils, but which has been subjected to such severe erosion that it has not accumulated much organic matter.

The soil as a whole lies much lower than remnants of the old loess plain on which the Holdrege soil is developed, and it is characterized by steep slopes and sharp divides. It occurs in all parts of the upland, wherever drainage has carved the gray loess into a rugged relief. In the more eroded sections soil slipping is common, and many of the steeper slopes present a succession of short vertical exposures locally known as catsteps.

The topsoil, which in few places is more than 6 or 7 inches thick, is loose friable silt loam ranging in color from dark grayish brown to ash gray, according to the severity of erosion to which the material has been subjected. In most places the 3- or 4-inch surface layer is darker than the rest of the topsoil, owing to the presence of a larger content of organic matter. The subsoil is light-gray or yellowish-gray floury silt which grades at a depth of about 20 inches into the very light gray or almost white parent loess. The subsoil and, in many places, the topsoil are very limy, the lime being in finely divided form and evenly distributed throughout the soil mass.

Colby silt loam as a whole is too rough for cultivation. However, it supports a good growth of nutritious pasture grasses, including grama, buffalo grass, June grass, and little bluestem, and, owing to its large extent, it is the leading pasture and native-hay soil in the county. The native grasses when pastured will support about 40 head of cattle on 160 acres during the summer grazing season, May to October, inclusive, or when cut for hay will yield about one half ton of hay to an acre. Some corn, wheat, and sorghum are grown in situations least subject to erosion, but yields are much lower than those obtained on Holdrege silt loam. Less than 4 percent of the soil is under cultivation.

Nuckolls silt loam, eroded phase.—The eroded phase of Nuckolls silt loam occupies 11 2 square miles. It has developed from a pale-red silty friable and limy loesslike material which underlies the gray loess of the uplands and is exposed locally in the more severely eroded sections, chiefly on the lower slopes of the deeper canyons. This eroded soil occurs in several bodies, the largest occurring along tributaries of Turkey Creek in Turkey Creek Township. An area comprising about 600 acres occurs along a tributary to Republican River in the extreme southeastern part of the county.

Most of the areas included with this soil are simply severely eroded exposures of the parent material, pale-red loess. In a few areas, however, organic matter has accumulated in sufficient quantities to give the 4- or 5-inch surface layer of the formation a dark grayish-brown or very dark grayish-brown color.

Aside from differences in the organic-matter content and color of the immediate surface layer, the only important variation in areas of Nuckolls silt loam, eroded phase, occurs east of Huntley along the

Franklin-Harlan County line. Here the pale-red loess has become mixed with an abundance of sand, has a sandy loam or loamy sand texture, and has been leached of its lime to a depth ranging from 5 to more than 6 feet. This somewhat red sandy material is classed with the Derby soils in Franklin County, but owing to its small extent in Harlan County it is included with Nuckolls silt loam, eroded phase

All the soil mapped as Nuckolls silt loam, eroded phase, in this county is topographically unsuited to cultivation and is used for pasture land. It supports the same species of grasses as grow on Colby silt loam and has about the same grazing value as that soil.

POORLY DRAINED UPLAND SOILS

The soils of this group, which include Butler silt loam and Scott silty clay loam, occupy only 0.9 percent of the total area of the county. These soils occur in depressions throughout the more nearly level parts of the uplands, principally in the northeastern and north-central parts of the county. Most of the run-off from the surrounding higher-lying soils accumulates in the basins and is forced to seek an outlet through downward seepage, removing clay and the more readily soluble salts from the surface layers and carrying them to lower levels. Continued downward translocation of material from the surface soil has resulted in the development of extremely dense and claypanlike upper subsoil layers and comparatively thin topsoils. It has also resulted in removing much organic matter from the topsoils, especially in Scott silty clay loam. The upper subsoil layers are almost impenetrable to water and are apparently penetrated with difficulty by crop roots. They are thickest and the topsoils are thinnest in areas where surface drainage has been most restricted.

About 50 percent of the area included in this group of soils is too wet to be used for cultivated crops, and some of the deeper depressions have little value even as pasture land. Most of the cultivated land is used for wheat. Corn does very well during spring and early summer, or as long as the soils remain moist, but it usually suffers severely from drought when the basins become dry, because the thin topsoils are unable to store sufficient moisture to maintain the crop during prolonged dry spells and the dense subsoils release their moisture too slowly for the growing corn crop. Wheat, on the other hand, usually matures before the occurrence of prolonged midsummer droughts and yields fairly well provided it is not drowned out early in the spring.

Butler silt loam.—Butler silt loam occupies the shallower basinlike depressions, and although more poorly drained than Hastings silt loam has not been subjected to so much excess moisture as Scott silty clay loam. Water accumulates after heavy rains in the basins occupied by this soil, but it seldom remains on the surface of the ground longer than a few days.

The topsoil, which ranges in thickness from 7 to 10 inches, is friable heavy silt loam. It is well supplied with organic matter, and the upper part is almost black. The lower part, although very dark, contains a noticeable quantity of light-gray silt particles, from which the organic coating has been leached. The upper part of the subsoil is nearly black dense clay which extends to an average depth of 30 inches. Beneath the clay layer is a gray friable silt containing an

abundance of lime, and the light-gray floury and limy loess from which the soil has developed occurs at a depth of about 4 feet beneath the surface of the ground.

About 75 percent of the land is under cultivation, principally to wheat. Yields are variable, but they average about 12 bushels an acre. Some corn is also grown, but this crop usually suffers severely during prolonged dry spells, and yields average rather low. The uncultivated parts of the soil support luxuriant growths of water-loving grasses and are used for pasture and hay land, for which they are well suited.

Scott silty clay loam.—Scott silty clay loam is the most poorly drained soil in the county. It occupies only the deeper and in general the smaller basins or buffalo wallows throughout the more nearly level uplands. The largest area, comprising about 700 acres, is in Antelope Township northeast of Ragan. The other bodies are few and in general include no more than 15 acres each.

The topsoil, although friable, is only 5 or 6 inches thick. It is well supplied with organic matter and is very dark to a depth of 3 or 4 inches. The lower part of the topsoil may or may not be dark, but in most places it contains sufficient leached silt to give the material a grayish-brown or almost white color. The subsoil consists of a layer of steel-gray or bluish-gray dense clay from 3 to 5 feet thick. It is almost impervious to water and is extremely difficult to penetrate with digging tools.

The soil is covered with water, often for weeks at a time, after heavy rains, and most of it is regarded as waste land. The larger bodies are included in farm pastures. Many of the smaller ones occur in cultivated fields but are seldom planted to grain crops on account of the poor drainage. The natural vegetation consists largely of coarse grass, reeds, and sedges, and the soil does not have a high value, even for grazing purposes.

BOTTOM-LAND SOILS

The soils belonging to this group occupy 6.7 percent of the total area of the county. They have developed from sediments recently deposited in the bottom lands during periods of high water, and they include the Lamoure, Cass, and Sarpy soils. One or another of these soils occurs as bodies or strips along all the larger and many of the smaller streams. The largest areas are along Republican River.

The surface of the bottom land slopes almost imperceptibly down the valleys and toward the stream channels. The land is remarkably smooth, except where traversed by old and present stream channels or where modified by slight elevations and shallow depressions. Surface drainage, although rather slow, is well established, except locally. Much of the land is subject to overflow during high stages of the streams, but as most of it lies from 3 to 5 feet above the stream channels, the water drains off in a few hours after the streams subside. About 80 percent of the land is sufficiently well drained for cultivation. The ground water table is everywhere within 12 feet of the surface of the ground, in many places much nearer, and the lower part of the subsoil is kept well supplied with moisture, even during the drier years.

The sediments from which the bottom-land soils have developed are of such recent origin that none of them has been greatly altered

by weathering, and their composition is the dominant factor in determining the character of the soils. The sediments deposited by the local upland streams flowing through areas of loess are naturally uniform and silty. Those deposited along Republican River came not only from the local uplands but from a variety of sources to the west, and they range in texture from silts to coarse sands. The Lamoure soils have developed from the silty or clayey stream sediments and are fine textured throughout, whereas the Cass and Sarpy soils are from the sands and gravels.

The moist conditions prevailing in the bottom lands have favored rapid vegetal growth and decay, and all the soils except the Sarpy, which is developed from the most recently deposited sediments, have dark-colored, in many places almost black, topsoils, owing to an abundance of organic matter.

The bottom-land soils as a whole are the most productive corn and alfalfa soils in the county. Most of the cultivated land on them is used for these crops in the proportion of about 9 acres of corn to 1 acre of alfalfa. Alfalfa can be grown as continuously as desired without decreasing the subsoil moisture to the point where yields decline, as they do in the uplands under continued alfalfa cropping. Small grains also grow well on all but the most sandy and poorly drained of the bottom-land soils, but they have a tendency to produce a rank vegetal growth accompanied by rather low grain yields. With the exception of barley and oats, which occupy a few fields, small grains are seldom grown on these soils.

The uncultivated parts of the bottom lands are used principally for native hay and pasture land. They occupy the more poorly drained areas, those which are extremely sandy and unstable and those which are covered with natural forest.

Sarpy loamy sand.—Sarpy loamy sand is the most extensive bottom-land soil. It occurs in fairly continuous strips of different widths on both sides of Republican River throughout its course across the county. The widest strips are between Alma and Republican City.

The soil consists largely of gray incoherent fine sand or medium sand, the topmost few inches of which contain sufficient silt, clay, and organic matter to give the material a loamy texture but not sufficiently loamy to prevent the sand from drifting during prolonged dry windy weather. In many places coarse sand and fine gravel occur below a depth of 2 feet. In most areas, lime is present below a depth of 18 inches.

The surface of the soil averages a little less level than that of the other bottom-land soils. In most places it is nearly level or very gently undulating, but in places the loose sand has been whipped by the wind into low mounds and ridges, thereby producing a rather hummocky appearance. The land lies from 2 to 3 feet above the normal river level and is subject to overflow in many places during periods of high water, but most of the water drains off or is absorbed by the porous sands, only the lower spots remaining wet on the surface of the ground longer than a few days after the stream subsides.

About 70 percent of this soil is under cultivation, and about 90 percent of the cultivated land is used for corn and alfalfa, in the proportion of about 12 acres of corn to 1 acre of alfalfa. The rest of the cultivated land is used for sweetclover, potatoes, and truck crops, chiefly melons. Corn yields are a little lower than those

obtained on the darker-colored bottom-land soils, on account of the low organic-matter content of this soil, but they equal or exceed those obtained on the best upland soils of the county, especially in dry years. Alfalfa and sweetclover yield almost as high as on the dark-colored Cass and Lamoure soils, probably because they do not depend on organic matter for their nitrogen supply. Truck crops yield a little lower than on Cass very fine sandy loam.

The uncultivated parts of this soil are included in small poorly drained areas and narrow forest-covered strips, and they are used chiefly for pasture land.

Sarpy very fine sandy loam.—Sarpy very fine sandy loam occupies only 3,264 acres. It occurs in a few narrow strips near or adjacent to the stream channels in Republican River and Prairie Dog Creek Valleys. Its surface is nearly level or very gently undulating and lies from 4 to 5 feet above the normal level of the streams. Although subject to overflow during periods of high water, only about 10 percent of the soil remains too wet for cultivation after the streams subside.

This soil resembles Sarpy loamy sand, except that it is composed of a finer grade of sand and is more stable than that soil. Practically all of that part under cultivation is used for corn and alfalfa, and the uncultivated parts are included in pasture or hay land. The average acre yield of corn is about 40 bushels and of alfalfa is about 3 tons of hay.

Lamoure silt loam.—Lamoure silt loam is the most productive corn and alfalfa soil in the county. However, it occupies only a small total area and is therefore of minor agricultural importance. Much of it is in the bottom lands along Sappa Creek, although fairly large bodies and narrow strips occur in the Republican River flood plains. Although the soil is subject to occasional overflow from the main streams, only about 15 percent of it remains too wet for cultivation.

The topsoil, which ranges in thickness from 10 to about 18 inches, is almost black friable silt loam containing an abundance of organic matter. The lower part is slightly heavier than the upper. The subsoil is light grayish-brown or gray silt loam or sandy clay loam, containing scattered rust-brown spots and splotches. It has a high lime content. In most places the material is a little heavier than the topsoil, but it is not compact and is easily penetrated by air, roots, and moisture.

The cultivable soil is used principally for corn and alfalfa. The average yield of corn is about 45 bushels an acre and of alfalfa, $3\frac{1}{2}$ tons of hay.

Owing to its high silt and clay content, this soil cannot be cultivated under so wide a range of moisture conditions as the Cass and Sarpy soils, but it is more productive than those soils and with reasonable care good tilth is easily maintained.

The poorly drained parts, as well as narrow forested strips, are used for pasture land.

Cass very fine sandy loam.—Cass very fine sandy loam is characterized by a dark friable very fine sandy loam or fine sandy loam topsoil about 10 inches thick and a gray or grayish-brown moderately limy sand subsoil. In most places the sand in the subsoil becomes coarser with depth and below a depth of 3 feet in many places contains a rather large quantity of gravel.

This soil occurs in several bodies in the Republican River bottom lands. The largest, comprising about 4 square miles, is southeast of Oxford on the south side of the river. Although subject to occasional overflow, practically all the land is adequately drained and under cultivation. It differs from Sarpy very fine sandy loam only in its higher organic-matter content and darker color of its topsoil.

Corn and alfalfa are the leading crops, the former occupying about 85 percent and the latter about 10 percent of the land in most years. Sweetclover, potatoes, and truck crops are grown on the remainder. Yields of all crops are from 10 to 15 percent higher than those obtained on any of the Sarpy soils, but they are a little lower, particularly yields of corn, than those obtained on Lamoure silt loam.

SOILS AND THEIR INTERPRETATION

The more persistent characteristics, or those common to most of the soils in Harlan County, are the result of the parent soil material and the climate, but soil differences, as well as the distribution of the individual soils in the county, are, with only a few exceptions, owing to differences in drainage conditions.

The parent material from which most of the soils have developed is light-gray floury and limy silt, known geologically as Peorian loess, and it is presumably fairly uniform in its chemical and physical properties. The regional soils-forming agency, climate, is also fairly uniform throughout the county, and its influence is strongly impressed on the soils. However, differences in the relief, that controls the rapidity of the surface run-off, the amount of moisture entering the soil, and the amount which stands on the surface, have produced marked differences, even in soils which have developed from the same or very similar parent formations.

Throughout the more nearly level uplands, those soils occupying depressed areas which receive the largest quantities of water show certain well-marked characteristics, among which are advanced stages of leaching and concentrations of clay in the subsoils. Soils in similar topographic positions, but which occupy well-drained areas, show less leaching and less concentration of clay, whereas those on steeply sloping or rough and broken areas, where surface run-off is rapid, show neither of these characteristics. The soils of the more nearly level uplands have been arranged in this report in four soil series, namely, Holdrege, Hastings, Butler, and Scott. These, in the order named, have developed under an increasingly larger and more continuous moisture supply. The most common characteristic of the topsoils in soils of these series is their dark color which is imparted by finely divided organic matter derived from the decay of grass roots and intimately mixed with the mineral components of the soil. The topsoils range from dark grayish brown to almost black in color and from 6 to 18 inches in thickness, both color and thickness depending on local drainage conditions and the amount of leaching to which the soils have been subjected. The most striking difference in these soils is in the character of the subsoil. This layer in different stages of development varies greatly in density and compaction, depending on the quantity of clay it has accumulated.

The soils of the Holdrege series, because of their gently undulating surfaces and good drainage, have not been subjected to sufficient moisture for the accumulation of much clay in their subsoils. The

following profile of Holdrege silt loam, the most extensive soil in the county, was observed on the nearly level uplands in a road cut near the southeastern corner of sec. 35, T. 4 N., R. 20 W., and is regarded as typical of this soil:

1. From 0 to 1 inch, dark grayish-brown structureless silt loam.
2. From 1 to 5 inches, very dark grayish-brown friable silt loam. The upper 2 inches of this layer is structureless, and the rest is laminated
3. From 5 to 17 inches, very dark grayish-brown structureless or mealy friable silt loam
4. From 17 to 25 inches, grayish-brown silty clay loam with a poorly developed nutlike structure. This is the layer of maximum compaction but is only slightly denser than the layer above. Some borings occur in this layer
5. From 25 to 33 inches, light grayish-brown structureless friable silt
6. From 33 to 52 inches, the zone of maximum carbonate accumulation. Very light grayish-brown or grayish-yellow loose structureless silt. Lime is abundant as coatings on lumps, in mycelium or fringe-like arrangements, and in finely disseminated form
7. From 52 to 75 inches, highly calcareous raw Peorian loess which is similar in appearance to the material in the layer above, except that it contains practically no visible concentrations or segregations of lime. The material is uniform to depths ranging from 12 to more than 14 feet.

All color and texture transitions between the different layers is very gradual, and, with the exception of the zone of maximum compaction, which undoubtedly contains the most clay, they are all very similar in texture. Layer 2 contains numerous worm casts, and layer 3 includes a few root, worm, or insect holes which have become filled with soil material of a slightly darker or lighter shade than the rest of the matrix. The dark color of the upper three layers is owing to an abundance of organic matter.

The soils of the Hastings series occupy almost level or very slightly depressed areas throughout the uplands. Most areas include lower-lying bodies of Scott or Butler soils, and, although surface drainage is much slower than on Holdrege silt loam, water does not stand on the surface of the ground as it does in the lower-lying bodies. A profile of Hastings silt loam examined at the southwest corner of sec. 6, T. 4 N., R. 17 W., has the same number of layers as the profile of Holdrege silt loam previously described. The upper two layers are almost identical with the corresponding ones in the Holdrege soil. The third is similar in color, texture, and consistence to the third layer in the Holdrege soil, but it is faintly granular in contrast to the structureless or mealy character of the corresponding layer in the Holdrege soil.

The fourth layers of the two soils differ only in compaction, the material in the Hastings soil being moderately compact, and that in the Holdrege relatively friable. The fifth layer, which occurs between depths of 26 and 40 inches in the Hastings profile, is thicker but otherwise similar to the corresponding Holdrege layer.

The lime zone in the Hastings soil lies deeper than that in the Holdrege soil, beginning at a depth of 40 inches and extending to a depth of 62 inches. It rests on raw Peorian loess similar to that beneath most of the upland soils in the county. The greater compaction in the fourth layer and the greater depth to lime in the sixth layer of the Hastings soil than in the corresponding layers of the Holdrege soil are undoubtedly owing to more moisture which has carried down larger quantities of clay and has penetrated deeper into the soil, thereby removing the lime to lower levels.

The soils of the Butler series are intermediate in both drainage and character between the Hastings and Scott soils. They occur in basins having no surface outlets, but which are shallower and have not been subjected to moisture in such large amounts or so continuously as those occupied by the Scott soils.

In a typical profile of Butler silt loam examined 64 rods west of the northeast corner of sec 9, T. 4 N, R. 17 W, the topsoil to a depth of 19 inches is very dark grayish-brown or almost black silt loam well supplied with organic matter. It does not differ materially from the material in the upper 17 inches of the previously described Holdrege profile. Between depths of 19 and 22 inches, however, the intensity of the dark color has been somewhat reduced by the partial removal of organic matter through leaching, and the material consists of dark grayish-brown friable silt. The next lower layer, which continues to a depth of 36 inches, is a true claypan, being composed of extremely dense structureless clay. Its upper one third has received much organic matter from the overlying layers and is almost black, but the remainder is dark grayish brown. Beneath the claypan and extending to a depth of 58 inches is the zone of maximum carbonate enrichment. This zone does not differ materially from the corresponding layer in the Holdrege soil, although more of the lime is in the form of semihard segregations and a few hard concretions occur. The material below the lime zone is light-gray floury and limy silt resembling that beneath the Holdrege and Hastings soils.

The development of the claypan layer in this soil is probably owing, in part at least, to the translocation of clay from the overlying layers through the agency of percolating waters. Readily soluble salts, possibly sodium, may also have contributed to the density of the claypan or may even have been the chief factor in determining its density, but as no analytical data are available on any of the claypan soils, it is not possible to make a definite statement in regard to the origin of the dense layers.

The zone of carbonate enrichment in the Butler soil lies nearer the surface of the ground than the corresponding zone in the Hastings soil. This condition is probably owing to the fact that moisture, although present in larger amounts on the surface of the Butler soil than on that of the Hastings, has not been abundant enough to penetrate the protective claypan layer in sufficient quantities for the removal of the lime beneath it.

The soils of the Scott series occupy the deeper and most poorly drained depressions throughout the uplands. Water stands over their surfaces for a large part of each year. Downward percolation of moisture, therefore, has been more continuous, and its results are more pronounced than in any other soil in the county. The topsoils in few places exceed 10 inches in thickness and in many places are much thinner. They vary considerably in structure, but most of them are more or less laminated. The color in the upper part is nearly black and in the lower part may or may not be dark. However, in most places the material is considerably leached and is gray or almost white. The subsoil, which continues to a depth ranging from 5 to 6 feet, is heavy olive-drab or bluish-gray structureless clay which is as dense as the material in any layer in the Butler soils. Beneath the clay is loose grayish-yellow loess, from which the soil has weathered. The excessive moisture has removed all traces of lime to a depth below 10 feet.

The soils in the rougher parts of the uplands are included with Colby silt loam and an eroded phase of Nuckolls silt loam. These soils have been subjected to excessive erosion, and their most common characteristic is the light color of their topsoils. The Colby soil, which is the more extensive of the two, has developed from the light-gray floury and limy Peorian loess similar to that underlying the Holdrege soils, but it occupies steep valley slopes and sharp ridge crests.

The eroded phase of Nuckolls silt loam has developed under conditions very similar to those prevailing in areas of Colby silt loam, but the Nuckolls soil has weathered from parent material known in the Nebraska surveys as the Loveland phase of the loess. This material is pale-red friable and limy silt containing some sand, chiefly of the finer grades. It underlies the Peorian loess of the upland and is exposed only in the deeper valleys or most severely eroded parts of the county. Most of the exposures are in the lower parts of the valley slopes.

The soils on the terraces are classed in the Hall and Bridgeport series. All these soils have developed under good but not excessive drainage. The Hall soils have weathered from Peorian loess which was washed down from the uplands and deposited as sediment on the valley floors when the streams were flowing at higher levels. Where typically developed their profiles are very similar to those of the Holdrege soils.

The Bridgeport soils are developed on terraces similar to those occupied by the Hall soils, but they have weathered from more recently deposited and slightly sandier sediments than those underlying the Hall soils. The outstanding features of these soils are the low organic-matter content and the uniformity of the entire soil profile. Sufficient time has not elapsed for the development of zones or layers of true soil character, and the soils consist of grayish-brown friable very fine sandy loam or fine sandy loam to a depth ranging from 3 to more than 4 feet.

SUMMARY

Harlan County is in south-central Nebraska, adjoining Kansas. It is nearly square and comprises 574 square miles, or 367,360 acres. It is part of a broad gently eastward-sloping loess-mantled plain which has been modified by the valleys of Republican River, Sappa Creek, and Prairie Dog Creek, all of which flow in a general easterly direction, and by numerous north-south drainage ways tributary to these streams. About 85 percent of the county is upland, and the remainder is alluvial land.

The average altitude is about 2,100 feet above sea level, and the range in elevation is about 450 feet.

All the drainage is effected by Republican River. The only poorly drained land occurs in a few shallow basinlike depressions on the uplands and in local spots on the flood plains.

The first permanent settlement was made in 1870, and the county was established and organized in 1871. The population, according to the 1930 Federal census, is 8,957, all classed as rural.

The climate is well suited to grain growing and livestock raising. The mean annual temperature at Alma is 51.6° F., and the mean annual precipitation is 22.58 inches.

The principal crops are corn, wheat, prairie hay, alfalfa, and oats, ranking in acreage in the order named. Minor crops include barley, sweetclover, potatoes, and garden vegetables. The cultivated crops occupy about 56 percent of the land. Wheat is the chief cash crop. The other crops grown, except those needed for family use, are fed to livestock, especially cattle and hogs, which are among the most important sources of revenue.

As a whole, the cultivated soils are naturally productive. Differences occur in the yields and crop adaptabilities of the different soils, but these are owing more to differences in the topographic features, particularly the slope of the land and its elevation with respect to surrounding areas or the underlying water table, than to differences in the soils themselves.

Harlan County is in the prairie region of the United States, and all the soils that are not severely eroded or have not developed from recently deposited and light-colored parent materials have dark topsoils, owing to an abundance of black organic matter derived from the decayed grass roots. In addition, most of the soils are characterized by an abundance of lime at slight depths and by friable topsoils and subsoils, which are easily penetrated by air, moisture, and crop roots.

The most extensive and agriculturally important soil is Holdrege silt loam, which has developed from light-gray floury and limy silt known as loess. It covers nearly all the well-drained, though not severely eroded, parts of the uplands. It has a deep dark mellow topsoil and a friable subsoil which is highly retentive of moisture. The soil is well adapted to all crops common to the region and is practically all under cultivation.

Hastings silt loam occupies a few nearly level areas in the northeastern part of the county. Its upper subsoil layer is a little more compact than that of Holdrege silt loam, but it is not dense or claypanlike and is easily penetrated by crop roots. Crop yields on this soil average a trifle higher than on any other upland soil, owing largely to a slightly larger content of soil moisture. However, the Hastings soil is not extensive and is of minor agricultural importance.

The Hall and Bridgeport soils occupy well-drained terraces. The Hall soils are similar in nearly all their characteristics to the Holdrege soils, but the Bridgeport soils are rather low in organic matter and light in color, even on the surface. All the terrace soils are very productive. They are more favorably situated to receive surface run-off from higher levels than the upland soils and produce higher yields of all crops than those soils.

Colby silt loam and an eroded phase of Nuckolls silt loam occupy the more severely eroded parts of the uplands. The Colby soil has developed from gray loess similar to that beneath the Holdrege and Hastings soils, but the rapid surface run-off has prevented the accumulation of much organic matter and the soil is light colored throughout. The Nuckolls soil has developed from pale-red, slightly sandy, loesslike material which underlies the gray loess and is exposed only in the deeper canyons. Practically all the area occupied by these soils is used for pasture land.

The Butler and Scott soils occur in poorly drained basinlike depressions throughout the uplands. Their subsoils have developed claypanlike layers which are penetrated with difficulty by crop roots.

These soils occupy only a small total area and are used chiefly for grazing and hay land, although some of the Butler silt loam is used for grain production, principally wheat.

The bottom-land soils of the county include the Lamoure, Cass, and Sarpy soils. The first two have developed dark-colored surface layers. The Lamoure soils are fine textured throughout, whereas the Cass and Sarpy soils are composed largely of sand. Most of the flood-plain soils are sufficiently well drained for cultivation and, owing to their abundant moisture supply, are the most productive corn and alfalfa soils in the county. Small grains also grow well, but they have a tendency to produce a rank vegetal growth at the expense of the grain.



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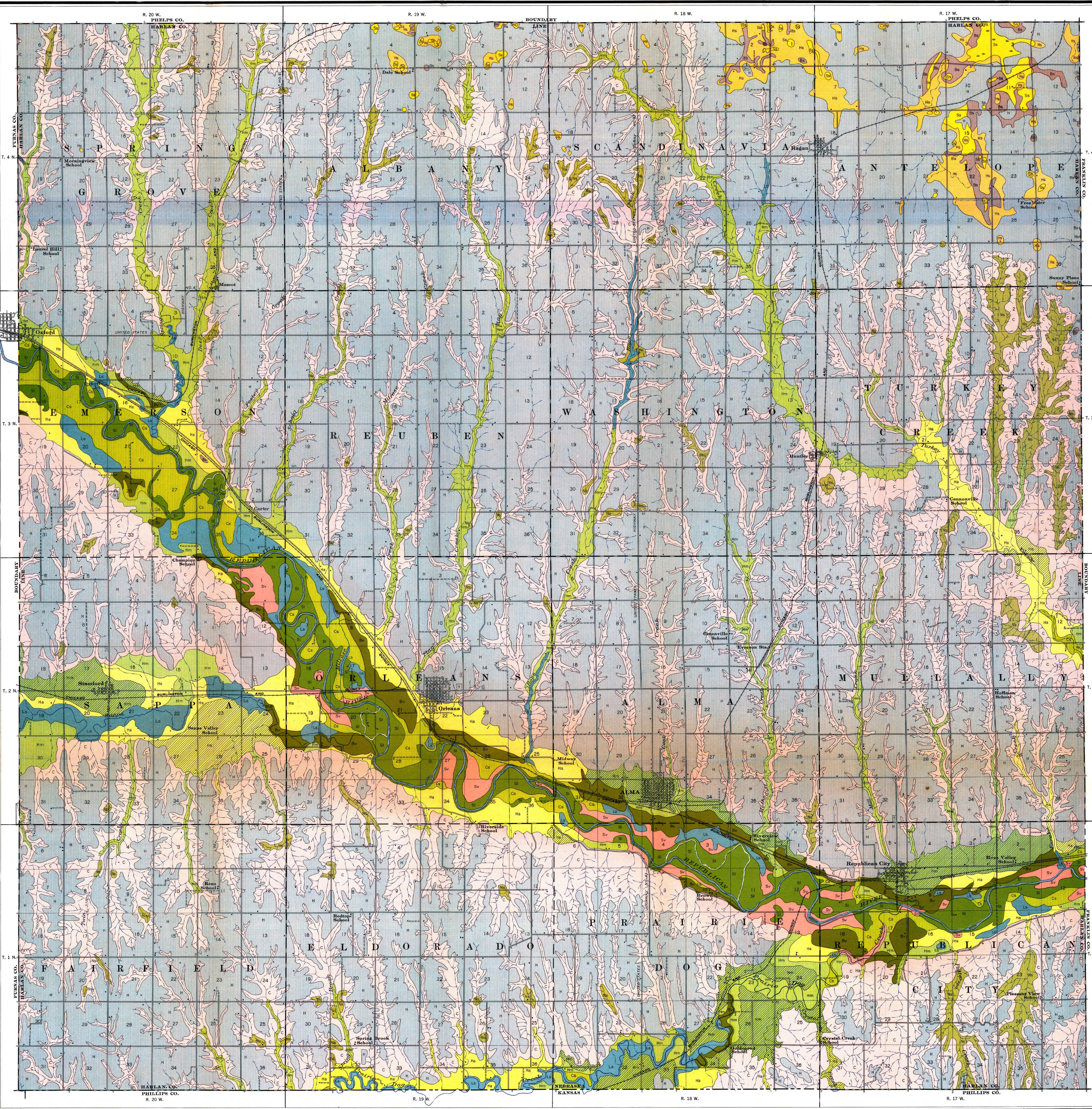
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LEGEND

Bridgeport very fine sandy loam Hs	Hastings silt loam Hs
Butler silt loam Bs	Holdrege silt loam Hs
Cass very fine sandy loam Cs	Lamoure silt loam Ls
Colby silt loam C	Nuckolls silt loam, Eroded phase Ns
Hall very fine sandy loam Hs	Sarpy loamy sand Ss
Hs High-terrace phase	Sarpy very fine sandy loam Sv
Hm silt loam Hm	Scott silty clay loam Ss
Hm High-terrace phase	

CONVENTIONAL SIGNS
(Printed in black)

 City or Village, Roads, Buildings, Wharves, Jetties, Breakwaters, Levees, Lighthouse, Fort.	 Railroads, Steam and Electric, R.R. crossings, Tunnel, School or Church, Cemeteries.
 Secondary roads and trails, Bridges, Ferry, Ford, Dam, Mine or Quarry, Mine dumps, Made land, Stony and Gravelly areas, Boundary lines, U.S. township and section lines.	 Contours, Prominent Hills, Mountain Peaks, Sand Wash and Sand dunes, Shore and Low-water line, Sandbar, Lakes, Ponds, Intermittent lakes, Springs, Canals and Ditches, Flumes, Submerged marsh, Tidal flats.

RELIEF
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DRAINAGE
(Printed in blue)

The above signs are in current use on the soil maps. Variations from this map of earlier dates.